

VI. NTSB Determination of Probable Cause

This document has previously focused on assessing the evidence available from the accident investigation and the data from testing. This information has been analyzed in terms of whether or not various hypothetical scenarios could have contributed to the accident. Scenarios considered have included those induced by either the system or the flight crew.

In this section, the “probable cause” standard to be applied to this investigation is discussed. The evidence is then summarized, and those scenarios that do not fit the definition are eliminated.

A. Definition of Probable Cause

Federal law directs the National Transportation Safety Board to investigate and “*establish the facts, circumstances, and ... probable cause*” of an aircraft accident. Everyone involved in this lengthy investigation has a strong interest in finding the “probable cause” of the accident. The clamor for a definite and expeditious explanation has been intense. In this atmosphere, the utmost care to ensure correctness is especially appropriate. As Chairman Hall recently testified, “The only thing worse than not waking up and giving the answer would be to wake up and give incorrect information or the wrong answer.”²⁷

In order to avoid the wrong answer, it is essential that any cause identified by the Board in this accident investigation be supported by facts and evidence. Mere suspicion, inference, and conjecture must not suffice. The Board has recently acknowledged, in the investigation of the United Airlines Flight 585 accident, that a theory cannot be elevated to a “probable cause” unless “conclusive” and “decisive” evidence exists in support of that explanation:

The National Transportation Safety Board, after an exhaustive investigation effort, could not identify *conclusive* evidence to explain the loss of United Airlines Flight 585.

The two most likely events that could have

resulted in a sudden, uncontrollable lateral upset are a malfunction of the airplane’s lateral and directional control system or an encounter with an unusually severe atmospheric disturbance. Although anomalies were identified in the airplane’s rudder control system, none would have produced a rudder movement that could not have been countered by the airplane’s lateral controls. The most likely atmospheric disturbance to produce an uncontrollable rolling moment was a rotor (a horizontal-axis vortex) produced by a combination of high winds aloft and the mountainous terrain. Conditions were conducive to the formation of a rotor, and some witness observations support the existence of the rotor at or near the time and place of the accident. However, too little is known about the characteristics of such rotors to conclude *decisively* whether they were a factor in this accident.²⁸

Using this standard for the USAir Flight 427 accident, the Board must first determine whether there are conclusive facts and evidence to support any theory before that theory can be identified as the “probable cause.” If a “probable cause” cannot be ascertained under this standard, the Board can still issue transportation recommendations to promote safety and reduce the likelihood of future accidents.

B. Summary of Evidence and Determination of Probable Cause

Table 4 summarizes the various hypothetical scenarios, both rudder system induced and flight crew induced. The scenario description, and any evidence supporting it, are included. The column on the right concludes whether the scenario can be considered for further evaluation as a probable cause based on the definition given in Section IV-A.

²⁷ Testimony of NTSB Chairman James Hall before the House Committee on Transportation and Infrastructure, Subcommittee on Aviation, regarding TWA Flight 800, July 10, 1997.

²⁸ *United Airlines Flight 585, Boeing 737-291, N999UA, Uncontrolled Collision With Terrain for Undetermined Reasons Four Miles South of Colorado Springs Municipal Airport, Colorado Springs, Colorado, Mar. 3, 1991*, NTSB Aircraft Accident Report 92/06 (PB92-910407), Dec. 8, 1992, p. 102.

Hypothetical Scenario Description	Indications For	Indications Against	Comments
1. Dual slide jam	<ul style="list-style-type: none"> Potentially fits a kinematic analysis 	<ul style="list-style-type: none"> Secondary slide can shear all chips No evidence of jam due to: <ul style="list-style-type: none"> - Chips - Corrosion - Particulates - Thermal cond No crew comment 	<ul style="list-style-type: none"> Evidence does not support finding as probable cause
2. Secondary slide jam and primary slide overtravel	<ul style="list-style-type: none"> Potentially fits a kinematic analysis 	<ul style="list-style-type: none"> Secondary slide can shear all chips No evidence of jam due to: <ul style="list-style-type: none"> - Chips - Corrosion - Particulates - Thermal cond CVR analysis <ul style="list-style-type: none"> a) No comments b) Straining is limited to autopilot on 	<ul style="list-style-type: none"> Evidence does not support finding as probable cause
3. Input linkage jam	<ul style="list-style-type: none"> Potentially fits a kinematic analysis 	<ul style="list-style-type: none"> No evidence of input crank jam (H-Link protects input crank from a jam) Extremely high forces available to overcome jam of input mechanism No reasonable mechanism has been identified for causing jam No crew comment 	<ul style="list-style-type: none"> Evidence does not support finding as probable cause
4. Flight crew input, no aircraft malfunction	<ul style="list-style-type: none"> Potentially fits a kinematics analysis Can be explained by behaviors documented in scientific literature CVR analysis indicates crew startled by wake Crew encountered unusually high roll accelerations in both left and right directions that could prompt a rudder input Crew input of left rudder can be explained by the concurrent removal of right wheel input 	<ul style="list-style-type: none"> No explicit statement on CVR of rudder input by crew VMC conditions make potential for vestibular disorientation unlikely Both pilots experienced in line operations 	

Table 4: Summary of Evidence

As this table shows, there is no evidence to support a conclusion that an uncommanded full rudder deflection occurred. While there is no conclusive evidence of a crew-commanded, sustained left-rudder input, such a possibility is plausible and must be seriously considered,

especially given the lack of evidence of an airplane-induced rudder deflection.